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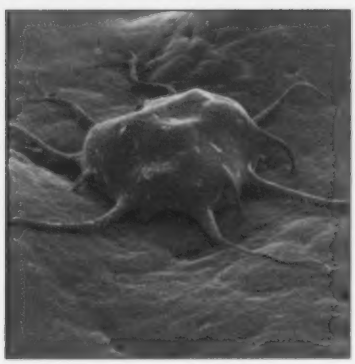
Article

Cancer prevalence in the Canadian population



by Larry F. Ellison and Kathryn Wilkins

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Abstract

Background

The rising numbers of cancer diagnoses, together with improvements in survival, have led to increases in the prevalence of cancer in Canada. This article provides more precise and detailed estimates of cancer prevalence than have been available previously.

Data and methods

Based on incidence data from the Canadian Cancer Registry linked with mortality data from the Canadian Vital Statistics Death Database, direct estimates of cancer prevalence as of January 1, 2005 were calculated for an extensive list of cancers, by time since diagnosis, age and sex.

Results

Two-, five- and ten-year cancer prevalence counts were 217,089 (675 per 100,000), 454,149 (1,412 per 100,000) and 722,833 (2,248 per 100,000), respectively. Breast (20.6% of ten-year prevalent cases), prostate (18.7%) and colorectal cancer (12.9%) were the most prevalent, together accounting for just over half of all cases. Prevalence proportions for all cancers combined increased dramatically with age, peaking at ages 80 to 84; proportions were higher in females than in males before age 60, and higher in males thereafter.

Interpretation

Prevalence data tabulated according to type of cancer, age and time since diagnoses provide important information about the demand for cancer-related health care and social services.

Keywords

epidemiologic methods, neoplasms, registries, surveillance

Authors

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Information on the prevalence of cancer in a population is important to health care planning. People diagnosed with cancer require treatment, monitoring for recurrence, and screening for other cancers. As well, they run the risk of permanent impairment or disability.[1] Cancer prevalence data provide an overall indication of the demand for cancer-related health care and social services and can be used to plan the future allocation of these resources.[1,2]

Cancer prevalence can be defined as the number of previously diagnosed cases of cancer in a given population, among people alive on a specified date (index date). Total prevalence refers to prevalent cases diagnosed at any previous time, while limited-duration prevalence refers to prevalent cases diagnosed within a specified number of years.

Categorizing cancer prevalence estimates according to time since diagnosis provides more precise indications of health care needs.[3] Cases diagnosed within ten years represent the major demand for cancer care services; more specifically, different health care services are required by cases that were diagnosed two or fewer, two to five, or five to ten years ago.[2,3] Cancer-specific prevalence data are also useful in planning resource allocation for treatment, care and follow-up because the management of each type of cancer is different.

Cancer prevalence is a function of both the incidence of and survival from the disease. In Canada, the number of newly diagnosed cases continues to rise,[4] and survival is also increasing.[5-8] The combined result is an increase in the number of people living with cancer, which leads to a growing demand for health care services.

Since 2003, the annual *Canadian Cancer Statistics* monograph has reported indirect estimates of 15-year prevalence for the leading cancers (female breast, prostate, colorectal and lung), and for all cancers combined.[9] The estimates for Canada were obtained by applying observed survival proportions derived from Saskatchewan

Cancer Registry data—most recently from cases diagnosed from 1986 to 2001, with follow-up to the end of 2002[10]—to national cancer incidence counts. With the maturity of the Canadian Cancer Registry (CCR), which contains information on cases diagnosed from 1992 onward, it is now possible to derive Canadian estimates of prevalence directly, using individual information on vital status. In addition, the demand for prevalence figures by time since diagnosis, age and for more than the leading cancers can be met.

Using data from the CCR, this report provides Canadian cancer prevalence estimates as of January 1, 2005. National estimates were directly derived for all cases except those diagnosed in the province of Quebec, for which it was necessary to use indirect methodology. Results were calculated by cancer, age group, sex and duration since diagnosis (that is, two-, five-, and ten-year prevalence).

Methods

Data source

Cancer incidence data are from the January 2008 version of the Canadian Cancer Registry, a dynamic, person-oriented, population-based database maintained by Statistics Canada. The CCR contains information on cases diagnosed from 1992 onward, compiled from reports from every provincial/territorial cancer registry. A detailed description of the CCR, including data sources, methodology and accuracy, is available on Statistics Canada's website.[11] Mortality data are from the Canadian Vital Statistics Death Database, also maintained by Statistics Canada. These data are based on information provided by the vital statistics registrars in each province and territory. Population estimates are from Statistics Canada's *Demographics Estimates Compendium 2007*.[12]

Analytical techniques

A file containing records of invasive cancer cases and *in situ* bladder cancer cases (the latter are reported for each province/territory except Ontario) was created using the multiple primary coding rules of the International Agency for Research on Cancer.[13] Cancer cases were classified based on the *International Classification of Diseases for Oncology, Third Edition* [14] and grouped using Surveillance, Epidemiology, and End Results (SEER) Program grouping definitions, with mesothelioma and Kaposi's sarcoma as separate groups.[15]

Mortality follow-up—complete through December 31, 2004—was determined through record linkage to the Canadian Vital Statistics Death Database, and from information reported by provincial/territorial cancer registries. For deaths reported by a provincial registry but not confirmed by record linkage, the date of death was assumed to be that submitted by the reporting registry. When the date of death was completely missing (n=77), the death was assumed to have occurred after the index date (January 1, 2005).

Prevalence can be calculated so as to estimate the number of people living with cancer on a specified date (person-based prevalence) or to estimate the total number of diagnoses of cancer among those alive on that date (tumour-based prevalence). The second method includes all qualifying cancers in the time-frame under consideration, regardless of whether they were first or subsequent primaries. Tumour-based prevalence is more useful in reflecting the demand for health care, because multiple cancers in an individual are usually treated independently.[1] Therefore, this report focuses on tumour-based prevalence. For completeness, however, estimates of person-based prevalence are provided in Appendix Tables A and B.

Prevalence was determined directly, using the counting method.[16,17] All primary invasive cancers (including *in situ* bladder cancer cases) among persons alive on January 1, 2005 that had been diagnosed in the time-frame under consideration were counted. Two-year prevalence was estimated by counting the number of invasive primary cancers diagnosed from January 1, 2003 to December 31, 2004 in persons who were still alive on January 1, 2005. Similarly, five- and ten-year prevalence estimates were based on cases diagnosed back to 2000 and 1995, respectively.

Because of issues involved in ascertaining the vital status of cases diagnosed in Quebec, prevalence data for this province were determined indirectly. The probability of surviving until the index date was used to randomly assign the vital status of each incident case in Quebec. Survival probabilities were derived using the corresponding observed survival proportion calculated for the rest of Canada, stratified on age group (0 to 39, 40 to 49, 50 to 59, 60 to 69, 70 to 79, and 80 or older), sex, cancer and month of diagnosis. Monthly survival estimates were calculated through ten separate analyses—one for each year of follow-up—using the life-table (actuarial) approach. Each analysis was based on cases diagnosed over a four-year span covering the most pertinent year (for example, 1995 for those months in the tenth year of survival) and the three preceding years. For cancers for which there were sufficient data—colon, rectum, lung and bronchus (lung), skin melanoma, female breast, corpus uteri, prostate, bladder and other—the eldest age group was sub-divided: 80 to 84, 85 to 89, and 90 or older.

Age-specific prevalence estimates were derived using the age attained by each case as of January 1, 2005. Year of birth was missing for 105 cases. Because the exclusion of these cases from the analysis would have led to an underestimation of prevalence, the attained age group was randomly imputed using the sex-specific attained age-group distribution of prevalent cases in Ontario (where virtually all of the 105 affected cases had been

diagnosed). Because of the relatively large percentage of prostate cancer cases (25%) among the cases with unknown age, and the uniqueness of the age distribution for this cancer, two attained age-group distributions for imputation were used for males: one for prostate cases, and one for all other cancers combined. Crude prevalence proportions (per 100,000) were calculated by dividing prevalence counts by the appropriate population on January 1, 2005 and multiplying by 100,000. Population estimates for this date were derived by averaging the 2004 and 2005 mid-year population estimates.

Trends in prevalence proportions across age groups were determined using the Average Annual Percent Change (AAPC) feature of the Joinpoint Regression Program (v 3.3) distributed by the SEER program of the National Cancer Institute in the United States.[18] Tests of statistical significance were conducted with alpha=0.05.

Results

Among persons alive in Canada on January 1, 2005, an estimated 722,833 primary invasive cancer cases (or 2,248 per 100,000 persons) had been diagnosed from 1995 through 2004 (Tables 1 and 2). (Appendix Table C contains age-standardized results.) Five- and two-year prevalence case counts were 454,149 (or 1,412 per 100,000 persons) and 217,089 (or 675 per 100,000 persons), respectively. For all cancers and ages combined, prevalent cases were nearly evenly distributed between the sexes for each duration period; the percentage of cases in males ranged from 48.9% (ten-year duration) to 50.9% (two-year duration).

Nearly 40% of ten-year prevalent cancer cases were either breast (20.5%) or prostate (18.7%) (Table 1, Figure 1). Colorectal cancer was the next most common (12.9%), followed by lung cancer (5.1%), bladder cancer (5.0%), non-Hodgkin lymphoma (4.1%) and skin melanoma (4.1%). The relative contribution of both breast and prostate cancer decreased when shorter prevalence periods were considered; each comprised about 17% of the two-year prevalent cases. The opposite pattern was observed for lung cancer: the relative contribution increased with shorter prevalence periods (6.1% for five-year; 8.1% for two-year).

In men, prostate cancer accounted for the largest share of ten-year prevalent cases (38.2%), followed by

Table 1
Number of prevalent cases, by prevalence-duration, cancer and sex, Canada, January 1, 2005

	Prevalence-duration								
	Two-year			Five-year			Ten-year		
Cancer	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females
All cancers	**217,089**	**110,595**	**106,494**	**454,149**	**228,318**	**225,831**	**722,833**	**353,508**	**369,325**
Oral cavity and pharynx	5,198	3,524	1,674	10,819	7,235	3,584	17,383	11,648	5,735
Esophagus	1,215	900	315	1,767	1,319	448	2,266	1,644	622
Stomach	2,890	1,911	979	4,791	3,056	1,735	6,875	4,229	2,646
Colorectal	29,554	16,048	13,506	60,700	32,736	27,964	93,489	49,603	43,886
Colon excluding rectum	19,438	9,838	9,600	40,005	20,070	19,935	62,123	30,781	31,342
Rectum and rectosigmoid	10,116	6,210	3,906	20,695	12,666	8,029	31,366	18,822	12,544
Anus	864	380	484	1,742	734	1,008	2,671	1,108	1,563
Liver	942	712	230	1,553	1,178	375	1,967	1,473	494
Pancreas	1,825	883	942	2,444	1,197	1,247	3,037	1,464	1,573
Larynx	1,861	1,521	340	3,908	3,215	693	6,701	5,479	1,222
Lung and bronchus	17,620	9,189	8,431	27,642	14,122	13,520	37,168	19,052	18,116
Soft tissue	1,442	793	649	3,001	1,645	1,356	4,891	2,623	2,268
Skin melanoma	7,722	4,078	3,644	17,459	8,961	8,498	29,602	14,697	14,905
Breast	37,391	306	37,085	86,552	598	85,954	148,542	947	147,595
Cervix uteri	2,346	..	2,346	5,433	..	5,433	9,995	..	9,995
Corpus uteri	6,894	..	6,894	15,373	..	15,373	26,467	..	26,467
Ovary	3,282	..	3,282	6,265	..	6,265	9,355	..	9,355
Prostate	37,583	37,583	..	85,956	85,956	..	135,065	135,065	..
Testis	1,557	1,557	..	3,817	3,817	..	7,091	7,091	..
Bladder (including in situ)	10,532	7,946	2,586	21,887	16,448	5,439	35,807	26,625	9,182
Kidney and renal pelvis	6,045	3,624	2,421	12,838	7,670	5,168	20,553	12,205	8,348
Brain	2,121	1,229	892	3,841	2,175	1,666	6,015	3,355	2,660
Thyroid	6,001	1,220	4,781	13,091	2,804	10,287	20,529	4,430	16,099
Hodgkin lymphoma	1,618	883	735	3,751	2,079	1,672	6,906	3,806	3,100
Non-Hodgkin lymphoma	9,253	4,930	4,323	18,991	10,015	8,976	29,619	15,316	14,303
Multiple myeloma	2,537	1,362	1,175	4,564	2,428	2,136	5,902	3,126	2,776
Leukemias	5,794	3,426	2,368	11,511	6,720	4,791	17,684	10,170	7,514
Other, unknown	13,002	6,590	6,412	24,453	12,210	12,243	37,253	18,352	18,901

.. not applicable
Source: Canadian Cancer Registry, Statistics Canada and Provincial/Territorial Cancer Registries.

Table 2
Prevalence proportions (per 100,000), by prevalence-duration, cancer and sex, Canada, January 1, 2005

	Prevalence-duration								
	Two-year			Five-year			Ten-year		
Cancer	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females
All cancers	**675.2**	**694.5**	**656.2**	**1,412.4**	**1,433.7**	**1,391.6**	**2,248.1**	**2,219.8**	**2,275.8**
Oral cavity and pharynx	16.2	22.1	10.3	33.6	45.4	22.1	54.1	73.1	35.3
Esophagus	3.8	5.7	1.9	5.5	8.3	2.8	7.0	10.3	3.8
Stomach	9.0	12.0	6.0	14.9	19.2	10.7	21.4	26.6	16.3
Colorectal	91.9	100.8	83.2	188.8	205.6	172.3	290.8	311.5	270.4
Colon excluding rectum	60.5	61.8	59.2	124.4	126.0	122.8	193.2	193.3	193.1
Rectum and rectosigmoid	31.5	39.0	24.1	64.4	79.5	49.5	97.6	118.2	77.3
Anus	2.7	2.4	3.0	5.4	4.6	6.2	8.3	7.0	9.6
Liver	2.9	4.5	1.4	4.8	7.4	2.3	6.1	9.2	3.0
Pancreas	5.7	5.5	5.8	7.6	7.5	7.7	9.4	9.2	9.7
Larynx	5.8	9.6	2.1	12.2	20.2	4.3	20.8	34.4	7.5
Lung and bronchus	54.8	57.7	52.0	86.0	88.7	83.3	115.6	119.6	111.6
Soft tissue	4.5	5.0	4.0	9.3	10.3	8.4	15.2	16.5	14.0
Skin melanoma	24.0	25.6	22.5	54.3	56.3	52.4	92.1	92.3	91.8
Breast	116.3	1.9	228.5	269.2	3.8	529.7	462.0	5.9	909.5
Cervix uteri	..	..	14.5	..	..	33.5	..	..	61.6
Corpus uteri	..	..	42.5	..	..	94.7	..	..	163.1
Ovary	..	..	20.2	..	..	38.6	..	..	57.6
Prostate	..	236.0	..	..	539.7	..	..	848.1	..
Testis	..	9.8	..	..	24.0	..	..	44.5	..
Bladder (including in situ)	32.8	49.9	15.9	68.1	103.3	33.5	111.4	167.2	56.6
Kidney and renal pelvis	18.8	22.8	14.9	39.9	48.2	31.8	63.9	76.6	51.4
Brain	6.6	7.7	5.5	11.9	13.7	10.3	18.7	21.1	16.4
Thyroid	18.7	7.7	29.5	40.7	17.6	63.4	63.8	27.8	99.2
Hodgkin lymphoma	5.0	5.5	4.5	11.7	13.1	10.3	21.5	23.9	19.1
Non-Hodgkin lymphoma	28.8	31.0	26.6	59.1	62.9	55.3	92.1	96.2	88.1
Multiple myeloma	7.9	8.6	7.2	14.2	15.2	13.2	18.4	19.6	17.1
Leukemias	18.0	21.5	14.6	35.8	42.2	29.5	55.0	63.9	46.3
Other, unknown	40.4	41.4	39.5	76.1	76.7	75.4	115.9	115.2	116.5

.. not applicable
Note: Prevalence proportions were determined by a tumour-based analysis.
Source: Canadian Cancer Registry, Statistics Canada and Provincial/Territorial Cancer Registries.

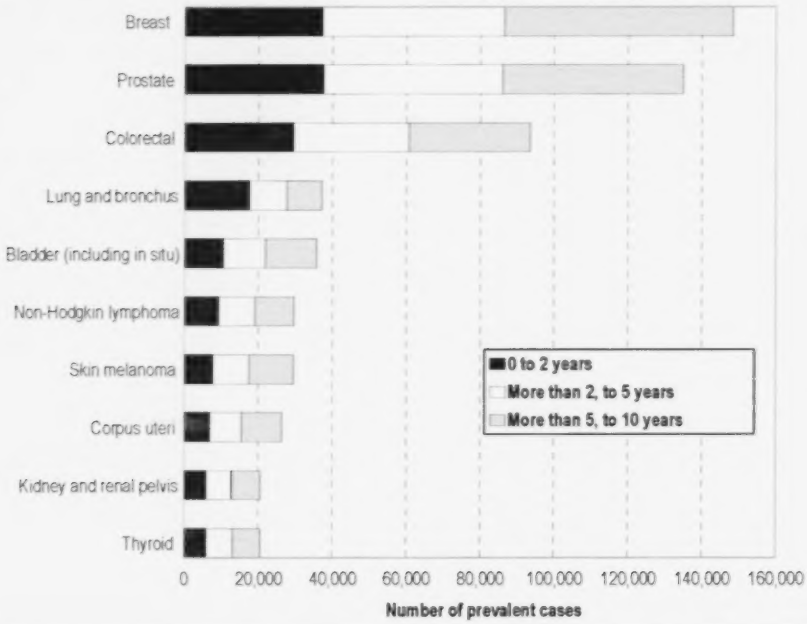
colorectal (14.0%), bladder (7.5%) and lung cancer (5.4%) (Figure 2). The corresponding most prevalent cancers in women were breast (40.0%), colorectal (11.9%), corpus uteri (7.2%) and lung (4.9%).

The increase with age in the prevalence proportion of cancer is striking. However, the patterns of increase differed between the sexes (Figure 3). In females, five-year prevalence exceeded that in males until just under age 60. Thereafter, mostly because of a sharp rise in prostate cancer, the proportions crossed over, and prevalence increased much more rapidly in males than in females. Prevalence proportions (per 100,000) peaked in the 80-to-84-year age group in both males (9,170) and females (5,179), and at older ages dipped to approximately the level at ages 70 to 74. The pattern was similar for two- and ten-year prevalence proportions (data not shown).

A statistically significant increase with age in sex-specific five-year prevalence proportions was observed for all cancers studied except testicular cancer among males, cervical and thyroid cancer among females, and Hodgkin lymphoma and brain cancer among both sexes (Table 3). Monotonic increases were observed across all age groups for some cancers, while for some others, the prevalence proportion rose with age and then fell in the oldest age group. For several cancers exhibiting the latter pattern, the proportion was at least 15% lower among persons aged 80 or older, compared with those aged 70 to 79. This was the case for thyroid, liver, and laryngeal cancer among males, and ovarian, lung, corpus uterine and kidney and renal pelvis cancer among females. For testicular cancer, and for Hodgkin lymphoma among both sexes, five-year prevalence proportions were highest in young adults (aged 20 to 39), and the decrease with age was statistically significant. For cancer of the cervix uteri and thyroid cancer among females, prevalence peaked at ages 40 to 49 and then decreased monotonically at older ages.

Although the number of prevalent cancers varied greatly by age group, similarities emerged in the types of cancers that were most common. In the three oldest age groups, the most common cancers in terms of ten-year prevalence (prostate, breast, colorectal, lung, and bladder) were the same, and their ranking relative to one another was quite similar (Figure 4). Breast,

Figure 1
Number of prevalent cases of ten leading cancers, by prevalence-duration, Canada, January 1, 2005



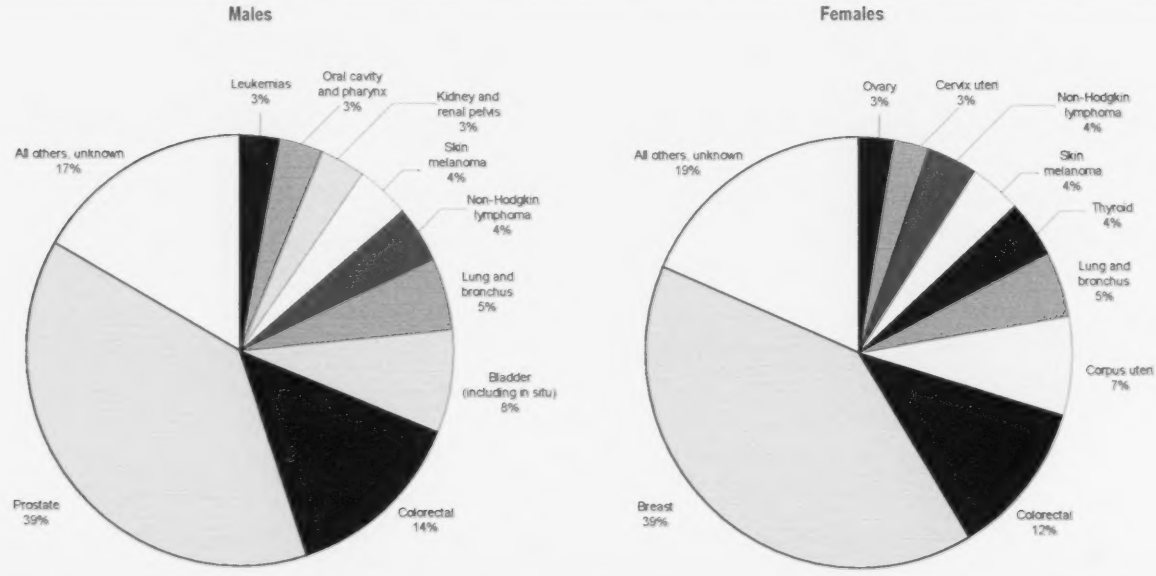
Source: Canadian Cancer Registry, Statistics Canada and Provincial/Territorial Cancer Registries.

prostate and colorectal cancer were also the most prevalent cancers among 50- to 59-year-olds; in this age group, however, the number of breast cancers was triple that of either of the other two. Breast cancer was similarly dominant in the 40 to 49 age group, ahead of thyroid cancer and skin melanoma. From age 20 to 39, thyroid cancer was the most prevalent, followed by testicular cancer, Hodgkin lymphoma, breast cancer and skin melanoma.

Discussion

This study provides two-, five-, and ten-year Canadian prevalence estimates by sex for an extensive list of cancers. From 1995 to 2004, just under 723,000 primary cancers were diagnosed in Canada among approximately 695,000 people who survived until at least the end of 2004. Breast, prostate and colorectal cancer were the most prevalent, accounting for just over half of all ten-year cases. The sex-specific prevalence proportions for all cancers combined rose dramatically with age—

Figure 2
Distribution of ten-year prevalent cancer cases, by sex and cancer, January 1, 2005



Source: Canadian Cancer Registry, Statistics Canada and Provincial/Territorial Cancer Registries.

Table 3
Age-specific, five-year prevalence proportions (per 100,000) for all cancers combined, by sex, Canada, January 1, 2005

	Age group						
Cancer	All ages	20 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 or older
Males							
All cancers	**1,433.7**	**183.8**	**486.0**	**1,656.30**	**4,898.2**	**8,287.8**	**8,945.3**
Oral cavity and pharynx†	45.4	5.4	34.2	88.6	147.3	180.1	186.6
Esophagus†	8.3	0.3	2.6	11.4	32.6	47.1	42.5
Stomach†	19.2	1.1	7.7	23.6	60.5	113.9	137.9
Colorectal†	205.6	8.3	55.5	236.0	679.3	1,268.0	1,589.9
Colon excluding rectum†	126.0	5.1	30.9	129.3	397.0	801.1	1,091.8
Rectum and rectosigmoid†	79.5	3.2	24.6	106.7	282.2	467.0	498.2
Anus†	4.6	0.5	3.3	7.4	16.0	20.0	23.1
Liver†	7.4	0.7	3.7	13.8	25.5	33.7	24.6
Pancreas†	7.5	0.6	4.2	12.1	27.9	33.6	39.4
Larynx†	20.2	0.4	5.9	28.7	83.1	114.8	94.6
Lung and bronchus†	88.7	2.0	19.3	97.4	324.9	596.1	543.3
Soft tissue†	10.3	5.0	9.3	13.6	20.4	37.0	45.9
Skin melanoma†	56.3	17.5	47.7	94.4	145.4	225.8	269.3
Prostate†	539.7	0.3	31.6	500.1	2,222.2	3,727.0	3,512.4
Testis‡	24.0	48.3	38.0	15.2	8.3	4.3	6.7
Bladder (including in situ)†	103.3	3.2	22.2	99.9	311.8	673.0	970.4
Kidney and renal pelvis†	48.2	4.8	31.0	84.1	158.9	219.3	209.4
Brain	13.7	11.1	16.3	17.6	20.6	18.2	15.0
Thyroid†	17.6	12.6	23.7	32.5	35.5	37.6	25.1
Hodgkin lymphoma‡	13.1	19.6	14.9	11.4	13.9	14.1	9.3
Non-Hodgkin lymphoma†	62.9	15.6	46.9	98.9	183.9	265.0	272.4
Multiple myeloma†	15.2	0.7	6.4	21.8	51.2	81.3	103.9
Leukemias†	42.2	10.2	20.7	51.3	111.9	176.1	243.1
Other, unknown†	76.7	15.5	39.4	91.9	205.4	380.9	547.7
Females							
All cancers	**1,391.6**	**293.8**	**1,067.8**	**2,229.0**	**3,643.7**	**4,742.7**	**4,934.9**
Oral cavity and pharynx†	22.1	4.8	17.3	33.5	53.6	78.0	85.9
Stomach†	10.7	1.0	4.9	11.4	24.2	47.5	68.3
Colorectal†	172.3	7.8	52.8	176.2	424.9	812.6	1,143.3
Colon excluding rectum†	122.8	5.2	32.8	114.9	290.0	592.4	873.4
Rectum and rectosigmoid†	49.5	2.6	20.1	61.2	134.9	220.2	269.9
Anus†	6.2	0.3	5.4	11.1	15.5	20.1	26.7
Pancreas†	7.7	0.7	3.6	9.4	21.9	33.0	37.7
Lung and bronchus†	83.3	2.6	35.3	116.6	282.9	398.9	270.7
Soft tissue†	8.4	4.8	7.8	10.0	15.5	19.8	26.8
Skin melanoma†	52.4	29.3	61.7	86.0	96.5	127.8	140.7
Breast†	529.7	59.3	477.9	1,033.4	1,473.9	1,638.6	1,568.0
Cervix uteri	33.5	32.3	61.2	49.9	45.6	40.4	34.5
Corpus uteri†	94.7	5.7	42.3	183.6	344.6	336.0	258.0
Ovary†	38.6	10.5	36.7	77.2	105.3	109.3	72.8
Bladder (including in situ)†	33.5	1.7	8.6	34.9	86.9	159.1	215.0
Kidney and renal pelvis†	31.8	4.5	20.6	46.7	87.0	127.6	108.0
Brain	10.3	9.1	11.6	12.5	14.7	12.3	6.2
Thyroid	63.4	64.2	105.6	103.8	93.3	68.0	39.7
Hodgkin lymphoma‡	10.3	18.4	8.7	8.2	7.4	10.9	7.2
Non-Hodgkin lymphoma†	55.3	12.4	35.4	76.3	152.4	211.2	206.4
Multiple myeloma†	13.2	0.5	4.5	15.7	36.1	62.8	71.5
Leukemias†	29.5	7.4	15.8	29.0	58.4	105.5	136.5
Other, unknown†	75.4	16.0	47.4	91.2	174.2	279.1	373.1

† statistically significant increasing trend in prevalence proportions across age groups
‡ statistically significant decreasing trend in prevalence proportions across age groups
Note: Prevalence proportions were determined by a tumour-based analysis.
Source: Canadian Cancer Registry, Statistics Canada and Provincial/Territorial Cancer Registries.

peaking at ages 80 to 84; proportions were higher in females than males before age 60 and higher for males thereafter.

For the first time, national figures are provided by age group and by prevalence-duration. The time elapsed since diagnosis provides a useful indicator of treatment need or follow-up services utilization. For example, just over 217,000 cancers had been diagnosed in 2003/2004 in persons who were still alive on January 1, 2005, and therefore, likely to be at a stage

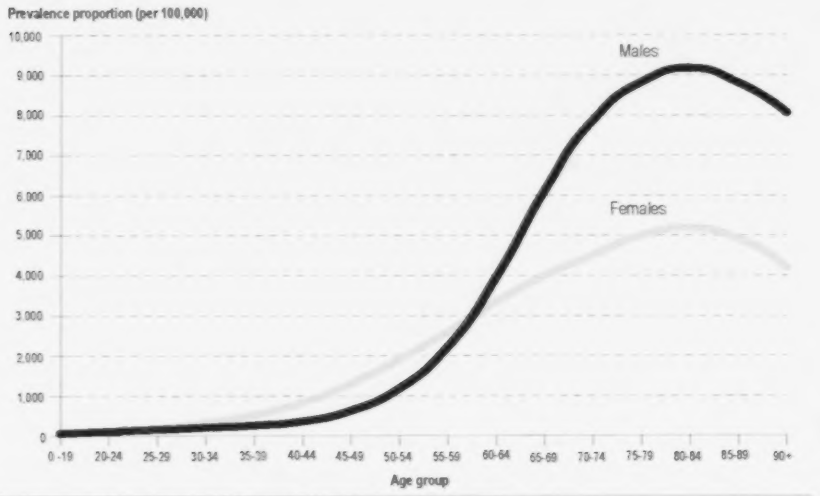
What is already known on this subject?

- Because of increases in the incidence of cancer and improving survival, the number of Canadians living with cancer is rising. This leads to a growing demand for cancer care services.
- Cancer prevalence data provide an overall indication of the demand for cancer-related health care and social services in a population and can be used to plan the future allocation of these resources.
- Prevalence estimates by time since diagnosis are especially relevant to resource planning; for example, estimates of five-year prevalence reflect fairly closely the number of cancers requiring active treatment or close follow-up care.

What does this study add?

- This study presents direct estimates of the prevalence of cancer in Canada. Estimates derived directly are more precise than those based on indirect methodology.
- For the first time, national figures are provided by age group and time since diagnosis.
- In addition to the four leading cancers, for which indirectly derived estimates have been reported previously, this analysis offers data for 22 other cancers.

Figure 3
Age-specific, five-year prevalence proportions for all cancers combined, by sex, Canada, January 1, 2005



Source: Canadian Cancer Registry, Statistics Canada and Provincial/Territorial Cancer Registries

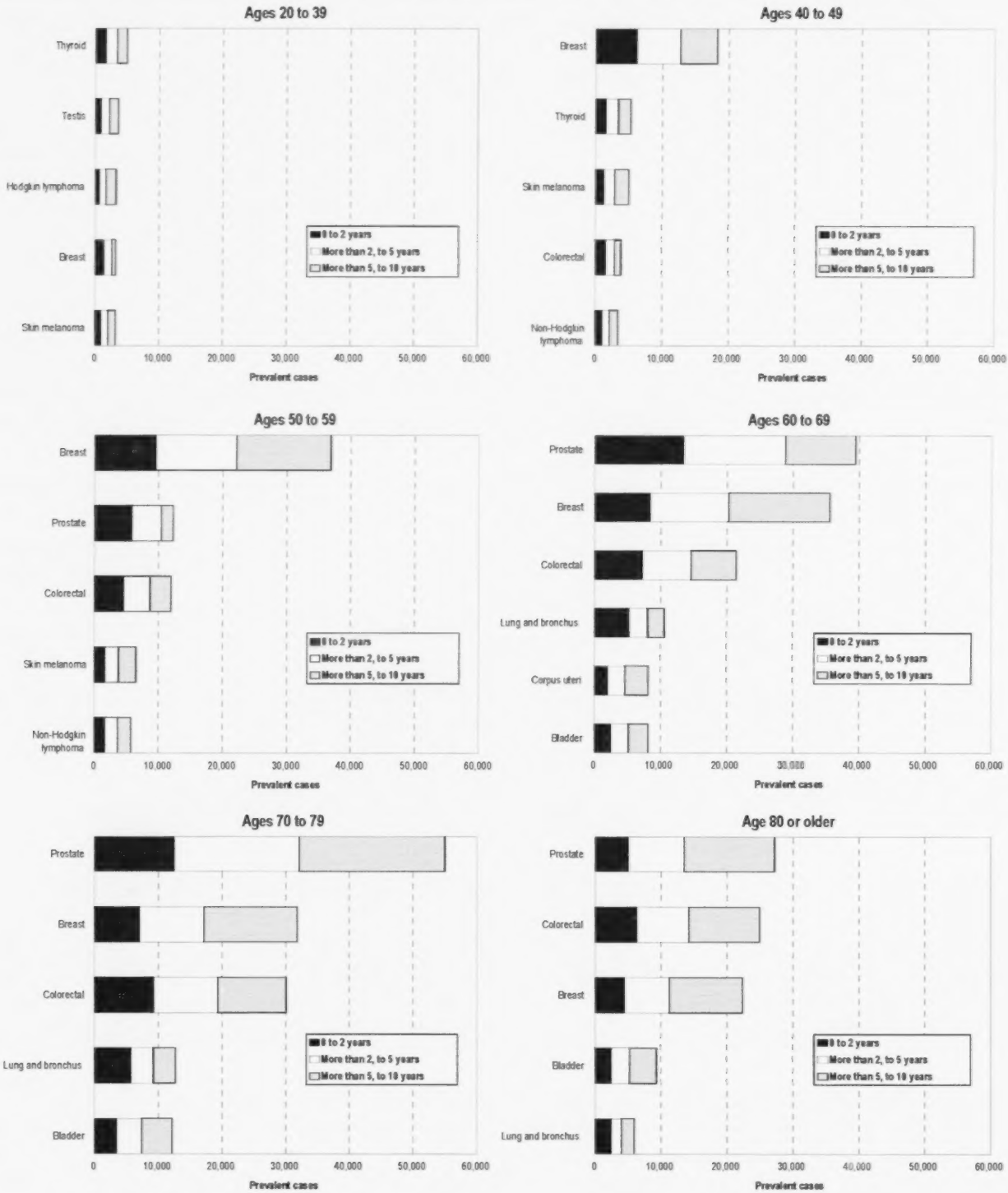
of the disease when they were undergoing primary treatment or recovering from its effects. In the period from two to five years since diagnosis—a time requiring close clinical follow-up for recurrence—the corresponding figure was just over 237,000. By age group, thyroid (ages 20 to 39), breast (ages 40 to 49 and 50 to 59), and prostate (ages 60 to 69, 70 to 79, and 80 or older) were the leading cancers.

Breast and prostate cancer were the most prevalent cancers in Canada—partly owing to their relatively high incidence,[4] but also because of favourable survival.[5,7] Despite the higher incidence of lung cancer during the period of study,[4] the number of prevalent colorectal cancer cases (ten-year) was over 2.5 times greater, reflecting the poor prognosis for those diagnosed with lung cancer.[5,7]

Sex-specific differences in the prevalence proportions for all cancers combined, before and after age 60, are also attributable to differences in incidence and survival. From age 25 to 54, incidence rates were considerably higher in females than in males, largely due to breast cancer. After age 60, as a result of a dramatic increase in prostate cancer rates, overall incidence rates were higher in males.[4] Also, in persons younger than 65, overall survival from cancer was higher for females than for males.[5]

After age-adjustment to the European standard population, current Canadian estimates of the five-year prevalence proportion for all cancers combined were approximately 9% higher for both sexes than those recently reported for France for 2002. The French estimates were derived indirectly and based on cancer registry data covering 15% of the country.[19] Model-based estimates of five-year crude prevalence proportions in 2005 were also recently reported for Italians younger than 85.[3] Again, the overall estimates for Canada were higher—by approximately 11% among males and 4% among females. Compared with both the Italian and French estimates, Canadian prevalence proportions were higher for prostate and female lung cancer, but lower for breast and male lung cancer. For colorectal cancer, Canadian estimates were higher than those for France but lower than those for Italy. Comparisons of Canadian estimates with those for

Figure 4
Number of prevalent cases of leading cancers, by age group and prevalence-duration, Canada, January 1, 2005



Source: Canadian Cancer Registry, Statistics Canada and Provincial/Territorial Cancer Registries.

the United States could not be undertaken because prevalence proportions for the latter are not reported for durations of less than 15 years.[15]

Limitations

Except for cases diagnosed in the province of Quebec, prevalence estimates were determined directly by using individual information on vital status—resulting in greater precision of results than if they had been determined indirectly. The extent to which indirect estimates of prevalence for Quebec reflect direct prevalence depends on the degree of similarity in cancer survival between Quebec and the rest of Canada—which may vary. Quebec contributes about one-quarter of Canada's incident cancer cases.

Cancer prevalence will be underestimated if the registration of new cases is incomplete. In Canada, case registration by the provincial/territorial cancer registries is generally considered to be quite complete.[20] In Quebec, however, because of the registry's dependence on hospital data, the numbers of microscopically confirmed prostate, melanoma and bladder cases have been estimated to be underreported by 32%, 35% and 14%, respectively.[21] In Ontario, the prevalence of bladder cancer was underestimated because *in situ* bladder cancer cases were not collected.

Persons whose cancer was documented in the CCR, but who moved out of the country and died before the index date, may have been erroneously considered as prevalent cases. However, they likely account for a minute proportion of the total number of prevalent cases, and their number may have been approximately offset by immigration of people with cancer into the country.

The possibility that some persons counted as prevalent cancer cases may have been cured was not considered in this study. To estimate the number of prevalent cases that have not been cured, statistical approaches have been applied to model "cure prevalence,"[22,23] but such analyses were beyond the scope of this study. Nonetheless, even among people who have been cured, cancer treatment can lead to long-term or permanent physical and psychological after-effects.

Conclusion

The current study presents the most precise and specific estimates of cancer prevalence in Canada that have been reported to date. The breakdown of prevalence estimates for an extensive list of cancers by time since diagnosis, age and sex provides much more detailed information about the cancer care needs of specific sub-populations than has been previously available. A valuable follow-up would be an examination of temporal trends in prevalence, leading to short- and long-term projections of these figures.

Acknowledgement

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References

1. Capocaccia R, Colonna M, Corazziari I, et al. Measuring cancer prevalence in Europe: the EUROPREVAL project. *Annals of Oncology* 2002; 13: 831-9.
2. Micheli A, Mugno E, Krogh V, et al. Cancer prevalence in European registry areas. *Annals of Oncology* 2002; 13: 840-65.
3. De Angelis R, Grande E, Inghelmann R et al. Cancer prevalence estimates in Italy from 1970 to 2010. *Tumori* 2007; 93: 392-7.
4. Statistics Canada. *Cancer Incidence in Canada* (Catalogue 82-231-XIE-2008001) Ottawa: Minister of Industry, 2008. Available at: http://www.statcan.gc.ca/pub/82-231-x/82-231-x2008001-eng.htm.
5. Statistics Canada. *Cancer Survival Statistics* (Catalogue82-226-XIE-2008001. Ottawa: Minister of Industry, 2008. Available at: http://www.statcan.gc.ca/pub/82-226-x/82-226-x2008001-eng.htm.
6. Ellison LF, Gibbons L. Leading cancers—changes in five-year relative survival. *Health Reports* (Statistics Canada, Catalogue 82-203) 2004; 15(2): 21-33.
7. Ellison LF, Gibbons L. Survival from cancer—up-to-date predictions using period analysis. *Health Reports* (Statistics Canada, Catalogue 82-003) 2006; 17(2): 19-30.
8. Ellison LF, Pogany L, Mery LS. Childhood and adolescent cancer survival: A period analysis of data from the Canadian Cancer Registry. *European Journal of Cancer* 2007; 43: 1967-75.
9. National Cancer Institute of Canada. *Canadian Cancer Statistics 2003*. Toronto: National Cancer Institute of Canada, 2003.
10. Canadian Cancer Society and National Cancer Institute of Canada. *Canadian Cancer Statistics 2008*. Toronto: Canadian Cancer Society and National Cancer Institute of Canada, 2008.

11. Statistics Canada. *Canadian Cancer Registry*. Ottawa: Health Statistics Division, Statistics Canada. Available at http://www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=3207&land=en&db=imdb&adm=8&dis=2. Accessed January, 2009.
12. Statistics Canada. *Demographic Estimates Compendium 2007* (Catalogue 91-213-SCB) Ottawa: Minister of Industry, 2008.
13. Parkin DM, Chen VW, Ferlay J, et al. *Comparability and Quality Control in Cancer Registration*. (IARC Technical Publications No. 19) Lyon: International Agency for Research on Cancer, 1994.
14. Fritz A, Percy C, Jack A, et al., eds. *International Classification of Diseases for Oncology, Third Edition*. Geneva: World Health Organization, 2000.
15. Ries LAG, Melbert D, Krapcho M et al., eds. *SEER Cancer Statistics Review, 1975-2005*,. Bethesda, Maryland: National Cancer Institute, 2008. Available at: http://seer.cancer.gov/csr/1975_2005/.
16. Feldman AR, Kessler L, Myers MH et al. The prevalence of cancer. Estimates based upon the Connecticut tumor registry. *The New England Journal of Medicine* 1986; 315: 1394-7.
17. Gail MH, Kessler L, Midthune D, et al. Two approaches for estimating disease prevalence from population-based registries of incidence and mortality. *Biometrics* 1999; 55: 1137-44.
18. Statistical Research and Applications Branch, National Cancer Institute. *Joinpoint Regression Program, Version 3.3 – April 2008*. Place of publication: Statistical Research and Applications Branch, National Cancer Institute, 2008.
19. Colonna M, Danzon A, Delafosse P et al. Cancer prevalence in France: Time trend, situation in 2002 and extrapolation to 2012. *European Journal of Cancer* 2008; 44: 115-22.
20. Howe HL, Lake A, Firth R, et al., eds. *Cancer in North America, 2001-2005. Volume Two: Registry-specific Cancer Incidence in the United States and Canada*. Springfield, Illinois: North American Association of Central Cancer Registries, Inc., 2008.
21. Brisson J, Major D, Pelletier E. *Évaluation de l'exhaustivité du fichier des tumeurs du Québec*. Quebec: Institut national de la santé publique du Québec, 2003.
22. Capocaccia R, De Angelis R. Estimating the completeness of prevalence based on cancer registries data. *Statistics in Medicine* 1997; 16: 425-40.
23. Coldman AJ, McBride ML, Braun T. Calculating the prevalence of cancer. *Statistics in Medicine* 1992; 11: 1579-89.
24. Curado MP, Edwards B, Shin HR, et al., eds. *Cancer Incidence in Five Continents, Vol. IX*. (IARC Scientific Publications No. 160) Lyon: International Agency for Research on Cancer, 2007.
25. Segi, M. *Cancer mortality for selected sites in 24 countries (1950-1957)*. Sendai: Department of Public Health, Tohoku University of Medicine, 1960.

Appendix

Sometimes the unit of measure of interest is the number of people living with a past diagnosis of cancer rather than the number of cancers. In terms of individuals, 695,049 persons had been diagnosed with one or more primary invasive cancers in the previous ten years and were alive on January 1, 2005 (Appendix Table B). Of these, 441,155 (63%) had been diagnosed in the previous five years, and 212,606 (31%) in the previous two years (Appendix Table A). These figures correspond to 2.2% of the estimated population on January 1, 2005, or approximately 1 in 46 persons (ten-year); 1.4%, or 1 in 73 persons (five-year), and 0.7%, or 1 in 151 (two-year) (Appendix Table B). One in every 111 females alive on January 1, 2005 had been diagnosed with breast cancer in the previous 10 years; the figure for prostate cancer was 1 in every 118 males.

For all cancers combined, person-based prevalence was defined as the number of people who had been diagnosed with a primary invasive (or *in situ* bladder) cancer in a given time-frame and who were alive on January 1, 2005. For example, five-year person-based prevalence for all cancers combined refers to the number of people alive at the beginning of 2005 who had been diagnosed with cancer within the period 2000 to 2004.

Cancer-specific, person-based prevalence was defined as the number of people diagnosed with a particular cancer in a given time-frame and who were alive on January 1, 2005. When cancers were combined for reporting purposes (for example, oral cancers, colorectal, leukemias and other and unknown), grouping was done before prevalence counts were determined.

The following example illustrates how cancers were counted in persons with more than one primary tumour diagnosis. For a person diagnosed with invasive primary breast cancers in 2001 and 2004, and also an invasive primary lung cancer in 2003, the 2001 breast cancer case and the lung cancer case would be counted in their respective five- and ten-year cancer-specific prevalence estimates. In calculating two-year prevalence estimates (based on cases diagnosed from January 1, 2003 to December 31, 2004), the lung cancer case and the 2004 breast cancer case would be counted in their respective cancer-specific prevalence estimates. There are other ways of determining person-based prevalence estimates in the case of multiple primaries, depending on the underlying question of interest; readers are invited to consider this when comparing person-based prevalence estimates from different sources. Note that, as defined above, the estimates of the prevalence of the individual cancers will not sum to the estimate given for all cancers combined.

Table A
Number of persons with cancer, by prevalence-duration, cancer and sex, Canada, January 1, 2005

	Prevalence-duration								
	Two-year			Five-year			Ten-year		
Cancer	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females
All cancers	**212,606**	**108,099**	**104,507**	**441,155**	**221,180**	**219,975**	**695,049**	**338,912**	**356,137**
Oral cavity and pharynx	5,145	3,496	1,649	10,715	7,170	3,545	17,199	11,531	5,668
Esophagus	1,215	900	315	1,767	1,319	448	2,264	1,642	622
Stomach	2,888	1,909	979	4,788	3,054	1,734	6,872	4,227	2,645
Colorectal	29,173	15,816	13,357	59,766	32,184	27,582	91,934	48,725	43,209
Colon excluding rectum	19,269	9,748	9,521	39,592	19,861	19,731	61,450	30,446	31,004
Rectum and rectosigmoid	10,110	6,205	3,905	20,670	12,647	8,023	31,322	18,793	12,529
Anus	863	380	483	1,740	733	1,007	2,669	1,107	1,562
Liver	942	712	230	1,553	1,178	375	1,967	1,473	494
Pancreas	1,824	883	941	2,443	1,197	1,246	3,036	1,464	1,572
Larynx	1,861	1,521	340	3,908	3,215	693	6,700	5,478	1,222
Lung and bronchus	17,530	9,145	8,385	27,480	14,050	13,430	36,875	18,915	17,960
Soft tissue	1,440	792	648	2,997	1,642	1,355	4,886	2,620	2,266
Skin melanoma	7,692	4,059	3,633	17,378	8,911	8,467	29,401	14,590	14,811
Breast	37,069	304	36,765	85,734	595	85,139	146,635	943	145,692
Cervix uteri	2,344	...	2,344	5,428	...	5,428	9,989	...	9,989
Corpus uteri	6,888	...	6,888	15,366	...	15,366	26,458	...	26,458
Ovary	3,279	...	3,279	6,260	...	6,260	9,350	...	9,350
Prostate	37,582	37,582	...	85,953	85,953	...	135,061	135,061	...
Testis	1,557	1,557	...	3,814	3,814	...	7,068	7,068	...
Bladder (including in situ)	10,526	7,944	2,582	21,870	16,438	5,432	35,772	26,604	9,168
Kidney and renal pelvis	6,032	3,616	2,416	12,798	7,642	5,156	20,485	12,155	8,330
Brain	2,120	1,228	892	3,840	2,174	1,666	6,012	3,353	2,659
Thyroid	5,958	1,213	4,745	12,976	2,780	10,196	20,361	4,398	15,963
Hodgkin lymphoma	1,618	883	735	3,751	2,079	1,672	6,906	3,806	3,100
Non-Hodgkin lymphoma	9,253	4,930	4,323	18,991	10,015	8,976	29,617	15,315	14,302
Multiple myeloma	2,537	1,362	1,175	4,564	2,428	2,136	5,902	3,126	2,776
Leukemias	5,794	3,426	2,368	11,511	6,720	4,791	17,684	10,170	7,514
Other, unknown	12,963	6,568	6,395	24,360	12,153	12,207	37,124	18,281	18,843

... not applicable
Source: Canadian Cancer Registry, Statistics Canada and Provincial/Territorial Cancer Registries

Table B
Prevalence proportions (per 100,000), by prevalence-duration, cancer and sex, Canada, January 1, 2005

	Prevalence-duration								
	Two-year			Five-year			Ten-year		
Cancer	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females
All cancers	**661.2**	**678.8**	**644.0**	**1,372.0**	**1,388.9**	**1,355.5**	**2,161.6**	**2,128.1**	**2,194.5**
Oral cavity and pharynx	16.0	22.0	10.2	33.3	45.0	21.8	53.5	72.4	34.9
Esophagus	3.8	5.7	1.9	5.5	8.3	2.8	7.0	10.3	3.8
Stomach	9.0	12.0	6.0	14.9	19.2	10.7	21.4	26.5	16.3
Colorectal	90.7	99.3	82.3	185.9	202.1	170.0	285.9	306.0	266.3
Colon excluding rectum	59.9	61.2	58.7	123.1	124.7	121.6	191.1	191.2	191.0
Rectum and rectosigmoid	31.4	39.0	24.1	64.3	79.4	49.4	97.4	118.0	77.2
Anus	2.7	2.4	3.0	5.4	4.6	6.2	8.3	7.0	9.6
Liver	2.9	4.5	1.4	4.8	7.4	2.3	6.1	9.2	3.0
Pancreas	5.7	5.5	5.8	7.6	7.5	7.7	9.4	9.2	9.7
Larynx	5.8	9.6	2.1	12.2	20.2	4.3	20.8	34.4	7.5
Lung and bronchus	54.5	57.4	51.7	85.5	88.2	82.8	114.7	118.8	110.7
Soft tissue	4.5	5.0	4.0	9.3	10.3	8.3	15.2	16.5	14.0
Skin melanoma	23.9	25.5	22.4	54.0	56.0	52.2	91.4	91.6	91.3
Breast	115.3	1.9	226.5	266.6	3.7	524.6	456.0	5.9	897.8
Cervix uteri	...	...	14.4	...	...	33.4	...	...	61.6
Corpus uteri	...	...	42.4	...	...	94.7	...	...	163.0
Ovary	...	...	20.2	...	...	38.6	...	...	57.6
Prostate	...	236.0	...	...	539.7	...	...	848.1	...
Testis	...	9.8	...	...	23.9	...	...	44.4	...
Bladder (including in situ)	32.7	49.9	15.9	68.0	103.2	33.5	111.3	167.1	56.5
Kidney and renal pelvis	18.8	22.7	14.9	39.8	48.0	31.8	63.7	76.3	51.3
Brain	6.6	7.7	5.5	11.9	13.7	10.3	18.7	21.1	16.4
Thyroid	18.5	7.6	29.2	40.4	17.5	62.8	63.3	27.6	98.4
Hodgkin lymphoma	5.0	5.5	4.5	11.7	13.1	10.3	21.5	23.9	19.1
Non-Hodgkin lymphoma	28.8	31.0	26.6	59.1	62.9	55.3	92.1	96.2	88.1
Multiple myeloma	7.9	8.6	7.2	14.2	15.2	13.2	18.4	19.6	17.1
Leukemias	18.0	21.5	14.6	35.8	42.2	29.5	55.0	63.9	46.3
Other, unknown	40.3	41.2	39.4	75.8	76.3	75.2	115.5	114.8	116.1

... not applicable
Note: Prevalence proportions were determined by a person-based analysis.
Source: Canadian Cancer Registry, Statistics Canada and Provincial/Territorial Cancer Registries.

Table C
Age-standardized* prevalence proportions (per 100,000), by prevalence-duration, cancer and sex, Canada, January 1, 2005

	Prevalence-duration								
	Two-year			Five-year			Ten-year		
Cancer	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females
All cancers	**434.3**	**467.8**	**411.6**	**899.7**	**955.2**	**868.0**	**1,402.1**	**1,448.9**	**1,393.4**
Oral cavity and pharynx	10.7	15.4	6.4	22.0	31.3	13.5	34.7	49.6	21.3
Esophagus	2.3	3.8	1.0	3.4	5.5	1.5	4.3	6.8	2.0
Stomach	5.3	7.7	3.2	8.7	12.3	5.6	12.3	16.8	8.4
Colorectal	53.5	64.7	43.5	107.8	130.2	88.5	161.5	193.7	134.3
Colon excluding rectum	34.4	39.1	30.2	69.3	78.5	61.5	104.4	118.1	93.1
Rectum and rectosigmoid	19.1	25.6	13.3	38.5	51.7	27.0	57.0	75.6	41.1
Anus	1.7	1.6	1.8	3.4	3.1	3.7	5.1	4.6	5.6
Liver	2.0	3.1	0.9	3.4	5.3	1.6	4.3	6.8	2.1
Pancreas	3.5	3.8	3.3	4.7	5.1	4.4	5.8	6.2	5.5
Larynx	3.7	6.5	1.3	7.7	13.5	2.5	12.9	22.5	4.4
Lung and bronchus	33.9	37.5	31.2	52.7	57.2	49.6	69.9	76.3	65.6
Soft tissue	3.4	3.8	3.0	7.0	7.9	6.3	11.3	12.5	10.3
Skin melanoma	16.2	17.6	15.2	36.5	38.5	35.2	61.3	62.9	60.9
Breast	75.6	1.2	144.9	173.3	2.4	331.9	291.4	3.7	555.9
Cervix uteri	..	..	10.7	..	..	24.6	..	..	44.2
Corpus uteri	..	..	27.2	..	..	59.5	..	..	98.9
Ovary	..	..	13.6	..	..	26.0	..	..	38.6
Prostate	..	156.4	..	..	348.9	..	..	525.8	..
Testis	..	8.8	..	..	20.9	..	..	37.2	..
Bladder (including in situ)	18.6	30.9	8.4	38.4	63.5	17.4	61.7	101.6	28.9
Kidney and renal pelvis	12.5	15.8	9.5	26.3	33.2	20.2	41.6	52.3	32.1
Brain	5.8	6.7	4.9	10.9	12.3	9.5	17.1	19.1	15.2
Thyroid	14.4	5.8	23.0	31.0	13.2	48.7	47.9	20.7	74.8
Hodgkin lymphoma	4.6	5.1	4.2	10.5	11.6	9.5	18.9	20.6	17.2
Non-Hodgkin lymphoma	18.9	21.7	16.3	39.0	44.2	34.1	60.4	67.5	53.9
Multiple myeloma	4.7	5.5	3.9	8.4	9.9	7.1	10.9	12.8	9.2
Leukemias	13.1	16.4	10.2	26.4	32.5	20.9	41.0	49.6	33.3
Other, unknown	25.7	28.2	23.8	48.9	52.8	46.0	74.4	79.4	70.7

* age-standardized to the World Standard Population [1,2]
.. not applicable
Note: Analysis was based on tumour-specific data.
Source: Canadian Cancer Registry, Statistics Canada and Provincial/Territorial Cancer Registries.